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The Indochina Entomologist
OPEN ACCESS
New Taxa
ICE, 1 (89): 883–890 (2025)
ISSN (Online) 3065-1107
www.indochinaentomologist.com

https://doi.org/10.70590/ice.2025.01.86
http://zoobank.org/urn:lsid:zoobank.org:pub:EC5DFDB5-685E-42C1-B5AC-F4A780F08AA2

Three new species of the genus *Anaxiphomorpha* from China (Orthoptera: Grylloidea: Trigonidiidae: Trigonidiinae)

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Abstract: In this study, three new species of the genus *Anaxiphomorpha* Gorochov, 1987, *A. cornea* He & Hu **sp. nov.**, *A. lingze* He & Hu **sp. nov.** and *A. dianxi* He & Hu **sp. nov.**, are reported from Yunnan, China. Their genitalia differ from those of all previously described species.

Keywords: cricket, morphology, Oriental Region, taxonomy, Yunnan

中国拟黄蛉蟋属三新种（直翅目：蟋蟀总科：蛉蟋科：蛉蟋亚科）

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摘要：本文报道了采集自中国云南的拟黄蛉蟋属三新种：角状拟黄蛉蟋 *A. cornea* He & Hu **sp. nov.**，灵泽拟黄蛉蟋 *A. lingze* He & Hu **sp. nov.** 和滇西拟黄蛉蟋 *A. dianxi* He & Hu **sp. nov.**，它们的雄性外生殖器显著有别于其他所有已知种。

关键词：蟋蟀，形态学，东洋区，分类学，云南

Citation: He Z-Q, Xia J-F & Hu T-H 2025: Three new species of the genus *Anaxiphomorpha* from China (Orthoptera: Grylloidea: Trigonidiidae: Trigonidiinae). *The Indochina Entomologist*, 1 (89): 883–890. [何祝清，夏静凡 & 胡天浩 2025: 中国拟黄蛉蟋属三新种（直翅目：蟋蟀总科：蛉蟋科：蛉蟋亚科）. 中南半岛昆虫学家, 1 (89): 883–890.]
https://doi.org/10.70590/ice.2025.01.89

Accepted by Zi-Xu YIN: 28.XI.2025; published online: 11.XII.2025

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Introduction

Since its establishment by Gorochov in 1987, the genus *Anaxiphomorpha* has been a member of the subfamily Trigonidiinae. The primary diagnostic feature is the unique shape of male genitalia: four elongated processes (lobes) at the rear edge of the epiphallus (Gorochov 1987). To date, this genus comprises nine species distributed in China and Vietnam (Gorochov 1987; Liu & Shi 2015; Ma 2018; He & Ma 2021). In this study, we examined specimens from our laboratory collection and described three new species. All type specimens are deposited in the Museum of Biology, East China Normal University (**ECNU**).

Material and methods

Sampling and Photographing

Specimens were collected by hand or with a net at night. Male genitalia were dissected, cleared in 10% NaOH solution, and subsequently preserved in a 1:1 glycerol-alcohol mixture. All morphological structures were photographed using a LEICA M125 camera and edited with Adobe Photoshop CS6 and Adobe Illustrator 2021 25.3.1.

Measurement abbreviations

The following measurements and indices were defined below.

Body length (BL): length from head to abdominal apex.

Pronotum length (PL): length from anterior margin to posterior margin of centre pronotum.

Forewing length (FWL): length from base to apex of forewing.

Hind femur length (HFL): length from anterior apex to posterior apex of hind femur.

Ovipositor length (OVL): length from base to apex of ovipositor.

Taxonomy

Order Orthoptera Olivier, 1789
Superfamily Grylloidea Laicharting, 1781
Family Trigonidiidae Saussure, 1874
Subfamily Trigonidiinae Saussure, 1874

Genus *Anaxiphomorpha* Gorochov, 1987

Anaxiphomorpha Gorochov, 1987: 15; Liu & Shi 2015: 433; Ma 2018: 197; He & Ma 2021: 14.

Type species: *Anaxiphomorpha brachyapodemalis* Gorochov, 1987 by original designation

Diagnosis. Body small but not slender; head not flattened above; 3rd and 5th segments of maxillary palp elongated, with the 5th segment not triangular in shape. In brachypterous individuals, tympanum open only on the outer side of foretibiae; in macropterous individuals, tympanum open on both side of foretibiae. Male: forewing well developed with a large mirror. Genitalia: epiphallus with a pair of medial lobes and a pair of lateral lobes at the posterior margin, and a pair of small, narrow projections on the dorsal side, each bearing a tuft of bristles. Female: forewing slightly convex with veins nearly parallel, no false vein; ovipositor relatively slender and curved upward. Body yellow, usually with brown lines on the vertex of the head. When alive, eyes black, pronotal disc usually with a brown square patch, separated by a longitudinally thin line.

The species of this genus are almost yellow (Fig. 1), a characteristic that distinguishes them from most other genera in China. In overall appearance, they are similar to *Svistella* Gorochov, 1987 and *Natula* Gorochov, 1987, except for the male genitalia. However, species of *Svistella* are comparatively larger than those of *Anaxiphomorpha*.

While *Natula* is very similar in appearance, it can be differentiated by its grey eyes, which are black in *Anaxiphomorpha* (Fig. 1).

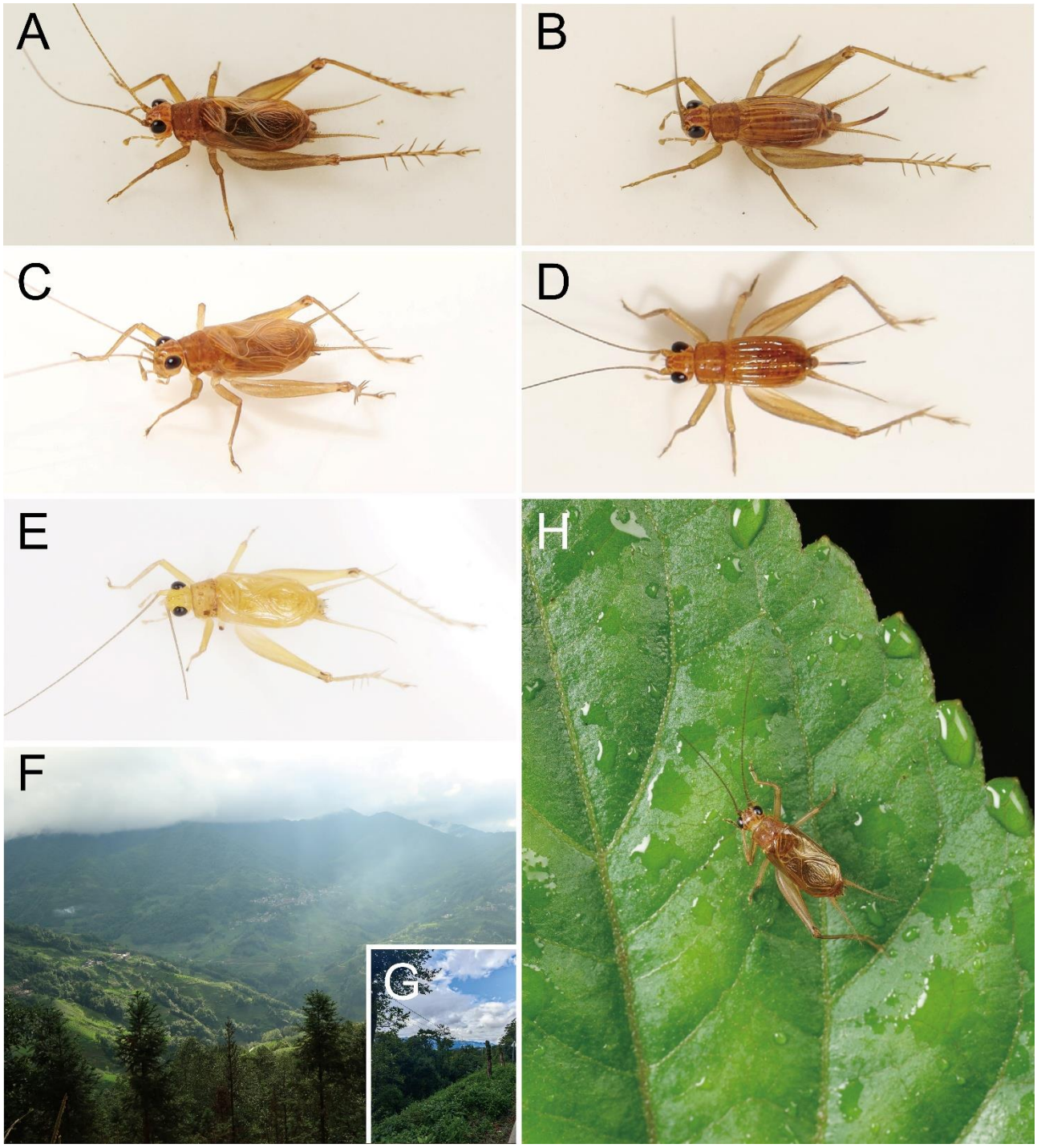

FIGURE 1. Habitat and living adults of *Anaxiphomorpha* species: **A, B** living male and female of *A. lingze* He & Hu **sp. nov. C, D** living male and female of *A. cornea* He & Hu **sp. nov. E** living male of *A. dianxi* He & Hu **sp. nov. F, G** habitat of *A. lingze* He & Hu **sp. nov. H** living *A. lingze* He & Hu **sp. nov.** in natural habitat. Photos by He Zhu-Qing, Hu Tian-Hao and Zhang Zi-Heng.

Anaxiphomorpha cornea He & Hu sp. nov. 角状拟黄蛉蟋

https://zoobank.org/2B936E32-5353-477F-B498-022997F0B995

Figs 1C, D, 2A, B, 3C, D, G, 4 A–C

Type material. Holotype: ♂ CHINA, Yunnan, Wenshan, Malipo, 104°43.44'E, 23°12.59'N, 10.VII.2021, leg. Zhu-Qing He, ECNU 4282. **Paratypes:** 1♂2♀, ECNU 4280, 4281 & 4283, other data same as holotype.

Diagnosis. Male genitalia: epiphallus with two pairs of lobes. Medial lobes axe-shaped with a distinct median notch, and lateral lobes robust and strongly incurved (Fig. 4 A–C). The notch on medial lobes distinguishes it from most species. It resembles *A. lingze* in the notch on the medial lobes, but can be separated by the shorter and wider medial lobes in lateral view. Moreover, the lateral lobes are distinctly curved apically in this species than those in *A. lingze* (lateral lobes are straight or only weakly curved in *A. lingze*).

Description. ***Male.*** Head: Eyes large and prominent, frons as wide as antennal scape, vertex not flattened (Fig. 2A). Maxillary palp with 3rd and 5th segments elongated; apex of 5th segment truncate, but not in triangular-shape.

Thorax: Pronotum trapezoid (narrower anteriorly, wider posteriorly). Tympanum open on outer side of foretibiae only (Fig. 3C, D). Forewings reaching nearly to apex of abdomen. Hindwings not visible. Mirror well-developed and large (Fig. 2A). Hind tibiae with three pairs of dorsal spurs; with five apical spurs, the two internal ones being longer.

Genitalia: Epiphallus with medial and lateral lobes. Lateral lobes robust and incurved, bearing tiny teeth on the inner margin of the apex. Medial lobes axe-shaped, with a distinct notch near the middle, dividing each into two smaller lobes: one directed posteriorly and one anteriorly (Fig. 4 A–C).

Female. Similar to the male. Forewings without a stridulatory organ. Veins almost straight, without false vein (Fig. 2B). Ovipositor slender and curved upwards, and bearing small denticles on both the dorsal and ventral sides along the apical third (Fig. 3G).

Coloration. Body yellowish brown. Two reddish brown bands on head. Pronotal disc reddish brown, separated by a longitudinally thin line (Fig. 1C, D).

Measurements (mm). Holotype: BL: 5.62; PL: 1.10; FWL: 4.21; HFL: 4.26. Paratypes: BL: ♂ 6.14, ♀ 4.33–4.97; PL: ♂1.09, ♀ 1.07–1.09; FWL: ♂4.53, ♀ 2.90–3.08; HFL: ♂4.48, ♀ 4.09–4.30; OL: ♀ 2.09–2.15.

Distribution. China (Yunnan).

Etymology. The species name cornea comes from the Latin for 'horn', referring to the shape of the outer lobes of the epiphallus.

Anaxiphomorpha lingze He & Hu sp. nov. 灵泽拟黄蛉蟋

https://zoobank.org/ADAF6F18-5BF4-496F-B5E6-707D33F6443D

Figs 1A, B, H, 2C, D, 3E, F, H, 4D–F

Type material. Holotype: ♂ CHINA, Yunnan, Honghe, Jinping, Fenshuiling Nature Reserve, 103°13.68'E, 22°54.09'N, 11.VI.2024, leg. Mi Di, ECNU 5723. **Paratypes:** 1♂3♀, leg. Tian-Hao Hu, ECNU 5722, NHL 001, ECNU 5728, ECNU 5729, other data same as holotype; 3♂, leg. Zi-Heng Zhang, ECNU 5724, ECNU 5725, ECNU 5726, other data same as holotype; 1♂1♀, leg. Mi Di, ECNU 5727, ECNU 5730, other data same as holotype.

Diagnosis. Male genitalia: Epiphallus with two pairs of lobes. Medial lobes axe-shaped with a distinct median notch, and lateral lobes robust and slightly incurved (Fig. 4D–F). The notch on medial lobes distinguishes it from most species. It resembles *A. cornea* in the shape of the medial lobes, but can be separated by lateral lobes: lateral lobes strongly incurved in *A. cornea*. Moreover, posterior smaller lobes of medial lobes longer in this species than *A. cornea*.

Description. ***Male.*** Appearance almost similar to *A. cornea* (Figs 2C, 3E, F), but different in male genitalia.

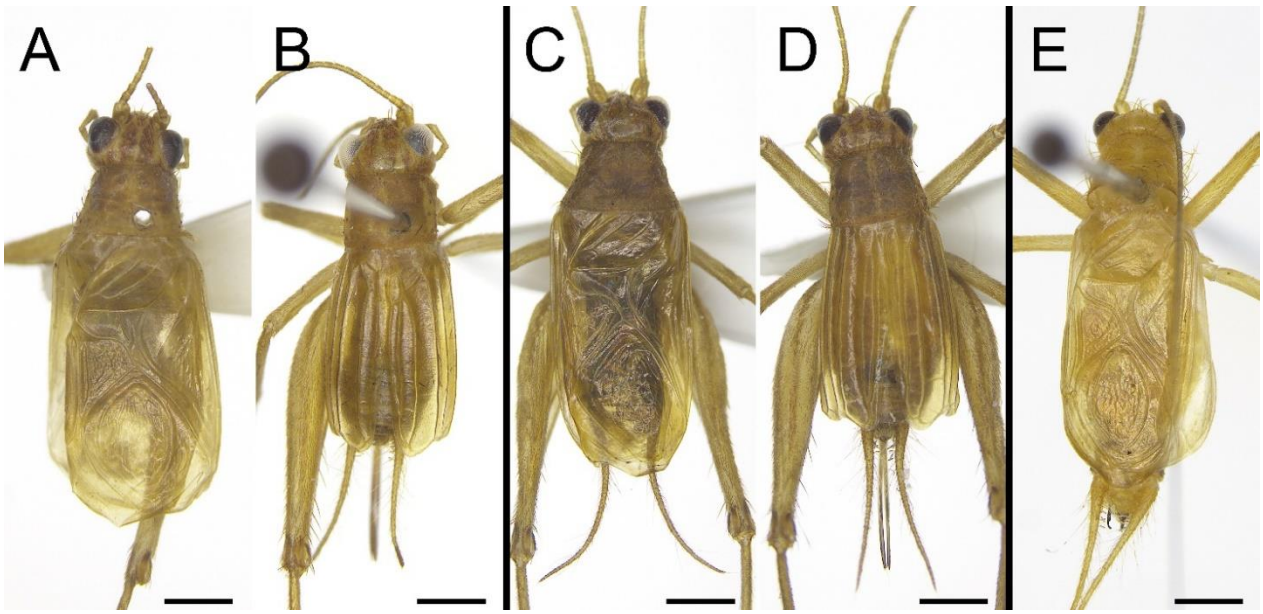

FIGURE 2. *Anaxiphomorpha* species in dorsal view: **A, B** male and female *A. cornea* He & Hu **sp. nov.** ECNU 4282 (holotype), ECNU 4281 **C, D** male and female *A. lingze* He & Hu **sp. nov.** ECNU 5723 (holotype), NHL 001 **E** male *A. dianxi* He & Hu **sp. nov.** ECNU 2308 (holotype). Scale bars = 0.5 mm.

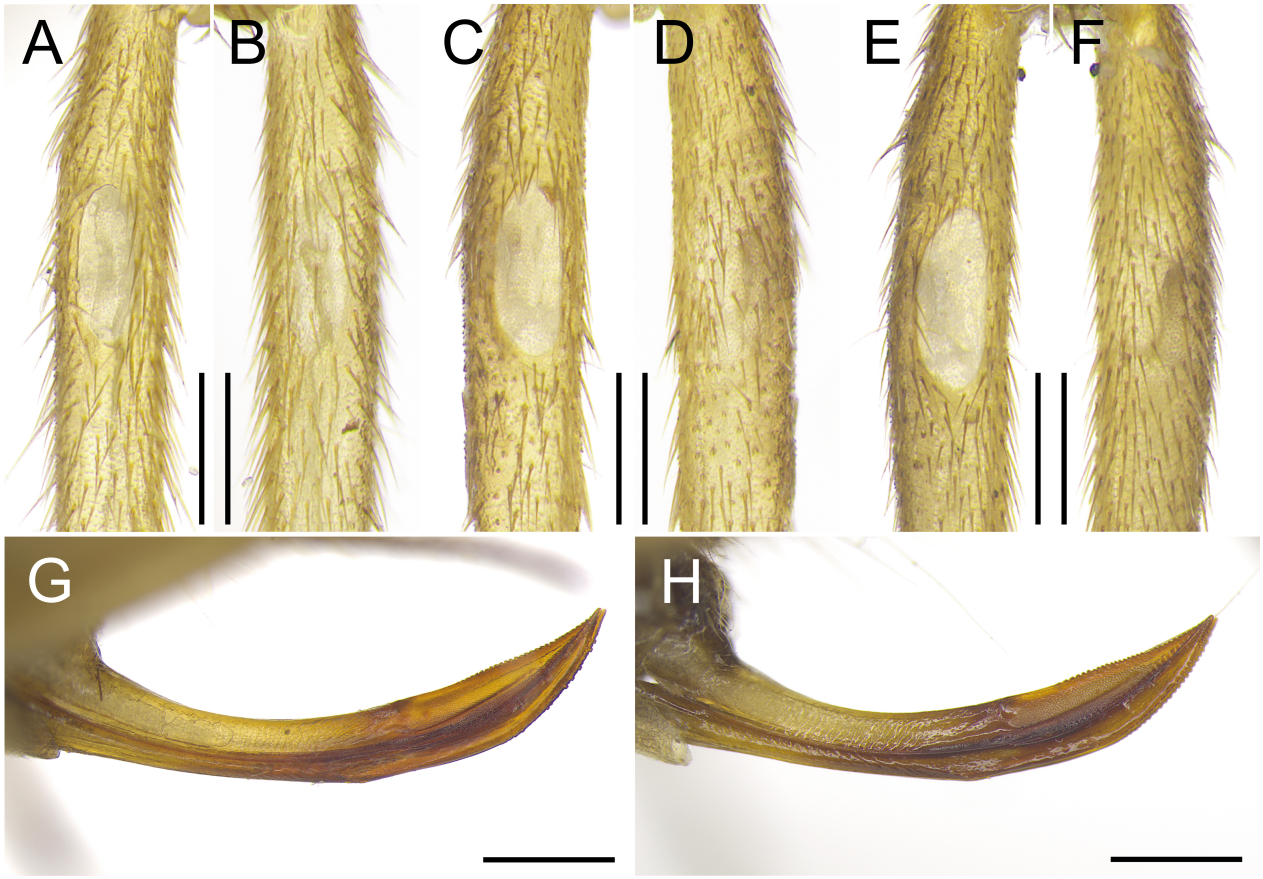

FIGURE 3. Tympana and ovipositors of *Anaxiphomorpha* species: **A, B** tympanum of *A. dianxi* He & Hu **sp. nov.** ECNU 2308 (holotype) **C, D** tympanum of *A. cornea* He & Hu **sp. nov.** ECNU 4282 (holotype) **E, F** tympanum of *A. lingze* He & Hu **sp. nov.** ECNU 5723 (holotype) **G** ovipositor of *A. cornea* He & Hu **sp. nov.** ECNU 4281 **H** ovipositor of *A. lingze* He & Hu **sp. nov.** NHL 001. Scale bars = 0.25 mm (A–F); 0.5 mm (G, H).

Genitalia: Epiphallus with medial and lateral lobes. Lateral lobes slightly incurved, bearing a row of tiny teeth on the inner margin of the apex. Medial lobes axe-shaped, with a distinct notch near the middle, dividing each into two smaller lobes: one directed posteriorly (long and curved) and one anteriorly (Fig. 4D–F).

Female. Similar to the male. Forewings without a stridulatory organ, veins almost straight, without false vein (Fig. 2D), ovipositor slender and curved upwards, and bearing small denticles on both the dorsal and ventral sides along the apical third (Fig. 3H).

Coloration. Body yellowish brown. Two reddish brown bands on head. Pronotal disc reddish brown, separated by a longitudinally thin line (Fig. 1A, B, H).

Measurements (mm). Holotype: BL: 5.29; PL: 1.03; FWL: 3.94; HFL: 4.27. Paratypes: BL: ♂ 4.80–5.28, ♀ 4.48–4.94 ; PL: ♂ 1.05–1.14, ♀ 1.04–1.11; FWL: ♂ 3.89–4.07, ♀ 2.89–3.03; HFL: ♂ 4.11–4.42, ♀ 4.03–4.54; OL: ♀ 2.15–2.29.

Distribution. China (Yunnan).

Etymology. The specific epithet '*lingze*' is the Pinyin transliteration of the Chinese characters '灵泽' for rain. It refers to the persistent rainy weather in Yunnan Province, China, where the specimens were collected in June (Fig. 1F, G).

Anaxiphomorpha dianxi He & Hu sp. nov. 滇西拟黄蛉蟋

https://zoobank.org/7E58D202-C98F-418C-889B-27ED1A4425EB

Figs 1E, 2E, 3A, B, 4 G–I

Type material. Holotype: ♂ CHINA, Yunnan, Dehong, Yingjiang, Nabang, 97°34.05'E, 24°44.79'N, 23.VIII.2019, leg. Zhu-Qing He, ECNU 2308. **Paratype:** 1♂ ECNU 2317, other data same as holotype.

Diagnosis. Body color yellowish compared with other species, pronotal disc without patch or stripe (Figs 1E, 2E). Male genitalia: Epiphallus with two pairs of lobes. Medial lobes axe-shaped without notch, and lateral lobes slender (Fig. 4G–I). Lateral lobes with only process at base, which distinguishes it from most species. However, it resembles *A. hexagona* and *A. nonggangensis* in lateral lobe shape, but can be distinguished from the former by the absence of an apical process and from the latter by its rounded, posteriorly pointed (vs. sharp, ventrally pointed) basal process.

Description. ***Male.*** Appearance almost similar to *A. cornea* (Figs 2E, 3A), but different in male genitalia.

Genitalia: Epiphallus with medial and lateral lobes. Lateral lobes slightly incurved, bearing a row of tiny teeth on the inner margin of the apex and a process each at base. Medial lobes axe-shaped, without notch near the middle (Fig. 4G–I).

Coloration. Body yellow (Fig. 1E).

Measurements (mm). Holotype: BL: 5.54; PL: 0.81; FWL: 4.09; HFL: lost. Paratype: BL: 5.76; PL: 0.93; FWL: 3.74; HFL: lost.

Distribution. China (Yunnan).

Etymology. The specific epithet *dianxi* is the Pinyin transliteration of the Chinese characters '滇西', which literally means "Western Yunnan".

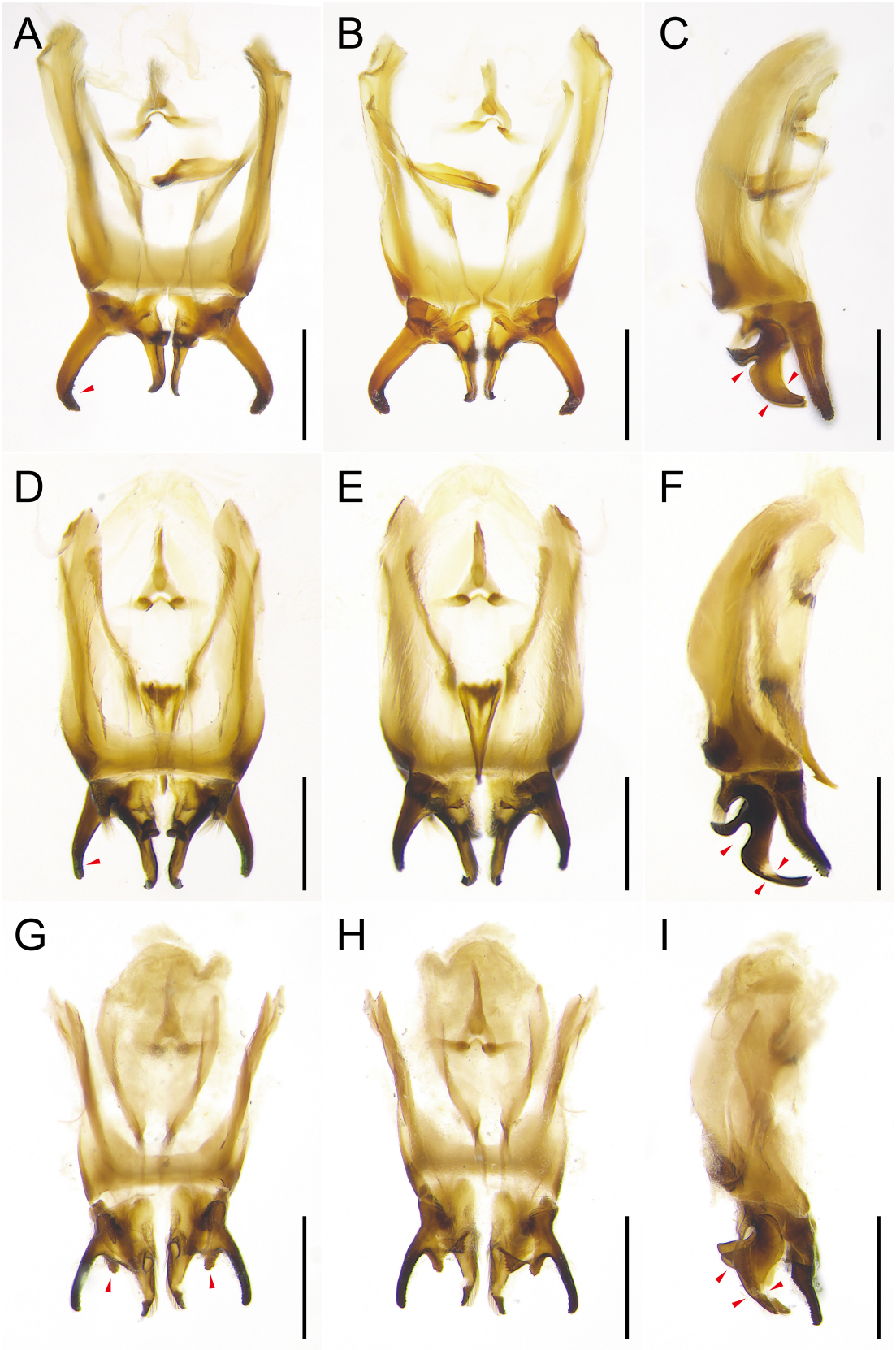

FIGURE 4. Male genitalia of *Anaxiphomorpha* species: **A–C** male genitalia of *A. cornea* He & Hu **sp. nov.** ECNU 4282 (holotype) in dorsal view, ventral view and lateral view, respectively **D–F** male genitalia of *A. lingze* He & Hu **sp. nov.** ECNU 5723 (holotype) in dorsal view, ventral view and lateral view, respectively **G–I** male genitalia of *A. dianxi* He & Hu **sp. nov.** ECNU 2317 in dorsal view, ventral view and lateral view, respectively. The red arrows indicate morphological differences between these three species. Scale bars = 0.5 mm.

Acknowledgements

We are sincerely grateful to anonymous reviewers and editors for their very constructive comments on the manuscript. We thank Mi Di and Zi-Heng Zhang for collecting important specimens and providing photos of habitats. We appreciate the Yunnan Jinping Fenshuiling National Nature Reserve Administration (云南金平分水岭国家级自然保护区管护局) for supporting our field work in Fenshuiling National Nature Reserve. This study is sponsored by the National Natural Science Foundation of China (No. 31801997).

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Additional information

Author contributions: Conceptualization: Z-Q He. Project administration: Z-Q He. Resources: Z-Q He. Supervision: Z-Q He. Visualization: Z-Q He, J-F Xia & T-H Hu. Writing–original draft: Z-Q He, J-F Xia & T-H Hu. Writing–review and editing: Z-Q He & T-H Hu.

Conflict of interest: The authors have declared that no competing interests exist.

Data availability: All of the data that support the findings of this study are available in the main text.

Ethical statement: No ethical statement was reported.

Funding: This study is sponsored by the National Natural Science Foundation of China (No. 31801997).

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